بسم الله الرحمن الرحيم

King Abdulaziz University
Engineering College
Department of Production and Mechanical System Design

MENG 470 Mechanical Vibrations

First Exam
Closed-book Exam
Tuesday: 9/6/1425 H
Time Allowed: 120 mins

Name:	Sec. No.:	ID No.:

Question 1		5
Question 2		5
Question 3		10
Question 4		10
Question 5		10
TOTAL		

قال الله تعالى : (تلك الدار الآخرة نجعلها للذين لا يريدون علوا في الأرض ولا فسادا والعاقبة للمتقين)

Instructions

1. This is a closed book and closed notes Opportunity to Shine
2. Show all work for partial credit.
3. Assemble your work for each problem in logical order.
4. Justify your conclusion. I cannot read minds.

بسم الله الرحمن الرحيم

Mechanical Vibrations	Closed Book Exam
MENG 470	Time: 2 Hours
First Exam	Tuesday: 9/6/1425 H

1) A harmonic motion has an amplitude of *0.20 cm* and a period of *0.15 s*. Determine the maximum velocity and acceleration.

2) A harmonic motion has a frequency of *10 cps* (*cps = cycles per second=Hz*) and its maximum velocity is *4.57 m/s*. Determine its amplitude, its period, and its maximum acceleration.

3) A machine of mass m=500 kg is mounted on a simply supported steel beam of length l = 2m having a rectangular cross-section (*depth = 0.1 m, width = 1.2 m*) and Young's modulus E=2.06 e^{11} N/m^2. To reduce the vertical deflection of the beam, a spring of stiffness k is attached at the mid-span, as shown below in Figure 1. Determine the value of k needed to reduce the deflection of the beam to one-third of its original value. Assume that the mass of the beam is negligible.

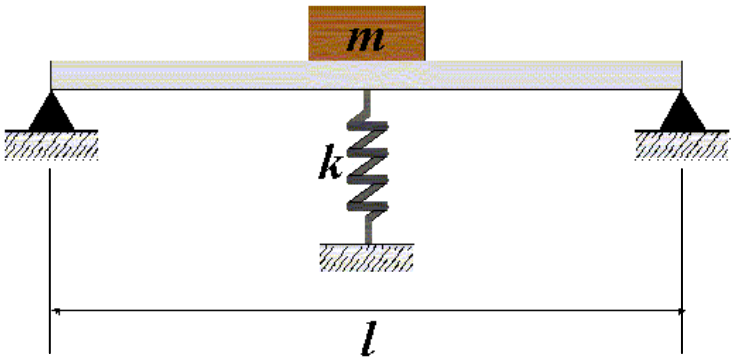

Figure 1

4) Write the equation of motion for the spring-mass system shown in Figure 2. Let its displacement *x(t)* be measured from:

a) the position for which both springs are unstretched. What is the natural frequency of the system?

b) the **static equilibrium position** of the system.

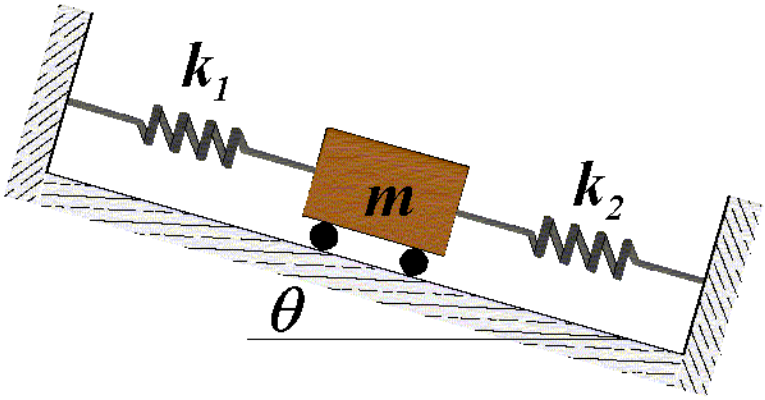

Figure 2

5) Imagine that you are a Vibrations Engineer working for ARAMCO company, where you are investigating the properties of a foundation that will be used to support an electric motor of weight mg =500 N. Your boss, Abdullah Joma'a, wants you to identify the following for the foundation:

a) The nature of damping provided by the foundation.
b) The damped and undamped natural frequencies of the motor/foundation combination.
c) The foundation stiffness and damping.

Thus you perform a free vibration tests whereby the motor—supported by the particular foundation—is released from rest with an initial displacement x_0 = 8 mm and the subsequent response is measured. The response is shown in Figure 3.

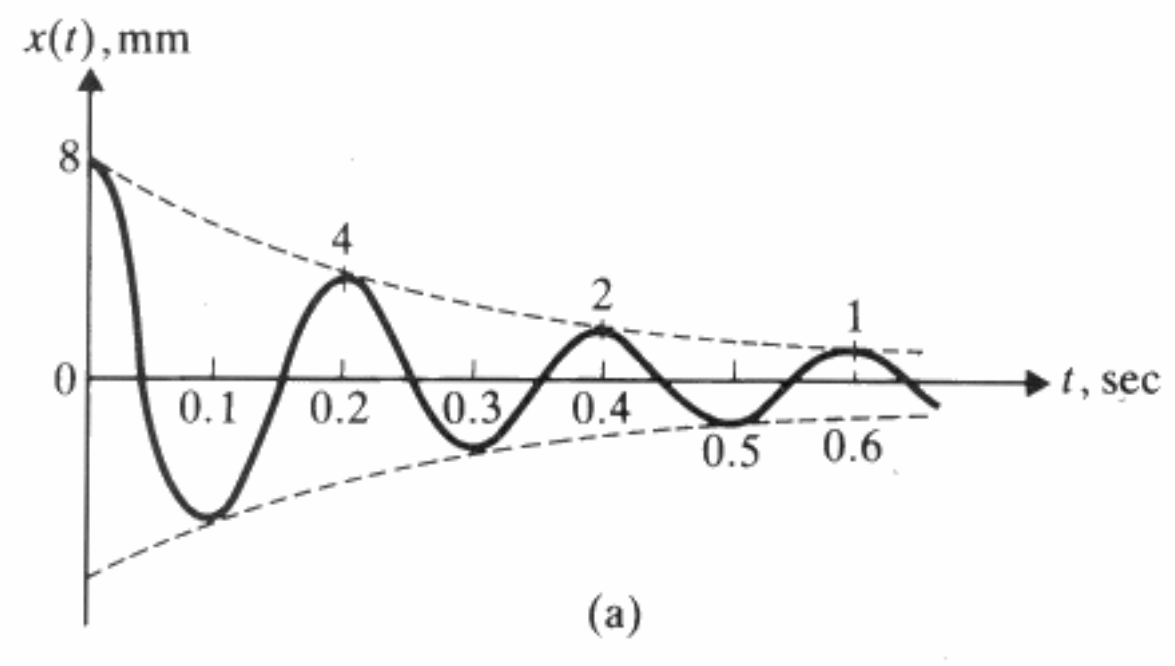

Figure 3